The Pharma Innovation Journal 2023; 12(3): 3054-3057

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(3): 3054-3057

www.thepharmajournal.com
Received: 19-01-2023
Accepted: 23-02-2023

Dipak Gavit
Department of Irrigation and Drainage Engineering, Dr. P.D.K.V. Akola, Maharashtra, India

Dr. MM Deshmukh
Associate Professor Department of Irrigation and Drainage Engineering, Dr. P.D.K.V. Akola, Maharashtra, India

Dr. SB Wadatkar
Head, Department of Irrigation and Drainage Engineering, Dr. P.D.K.V. Akola, Maharashtra, India

Corresponding Author:
Dipak Gavit
Department of Irrigation and Drainage Engineering, Dr. P.D.K.V. Akola, Maharashtra, India

Estimation of water requirement and water use efficiency of hybrid brinjal crop under drip fertigation and traditional fertilization methods

Dipak Gavit, Dr. MM Deshmukh and Dr. SB Wadatkar

Abstract
A field experiment was conducted for estimation of fortnightly total water requirement of hybrid brinjal crop under drip fertigation and traditional fertilization methods at Dr. PDKV, Akola during November 2021 to May 2022. The experiment was laid down in randomized block design with four drip fertigation levels (75, 100, 125 and 150% of RDF) and one control treatment of traditional fertilization method. All these treatments are replicated four times. The study showed that the fortnightly total water requirement of hybrid brinjal crop ranges from 5.99 lit per plant to 74.00 lit per plant i.e. 8.87 mm to 109.63 mm. The total irrigation water requirement of hybrid brinjal crop was found to be 550.88 mm under 80% ET level i.e. 371.85 litres per plant. The highest yield of brinjal was recorded in treatment T_4 (drip fertigation with 150% of RDF) (470.33 q/ha) which was followed by treatments T_3, T_2, T_1, T_5 and found statistically at par with treatment T_3 (drip fertigation with 125% of RDF). Highest water use efficiency was recorded in treatment T_4 (drip fertigation with 150% of RDF) (8.54 q/ha-cm) which was followed by treatments T_3 T_2 T_1 and T_5. Treatment T_5 (Traditional fertilization at 100% of RDF) recorded the lowest water use efficiency.

Keywords: Brinjal, water use efficiency, drip fertigation, water requirement

1. Introduction
Water is a priceless natural resource, a necessity for all living things, and a key national asset. The extent to which water is plentiful or scarce, clean or polluted, beneficial or destructive, profoundly influence the extent and quality of human life. India's population is growing by roughly 2% annually. To ensure a healthier food consumption, it is crucial that food production rise by around 2.5% annually (Michael, 2008) [4]. The usage of the available water resources must be prioritised properly in order to be optimally harnessed and effectively utilised. To sustainably accomplish the goals of economic growth and quality of life, long-term perspective planning of water resources is necessary.
Two of the most crucial elements in the production of vegetables are fertigation and irrigation since they have a significant impact on crop yield and quality. Fertigation is a modern agro-technical operation in which fertilizer is dissolved in the irrigation water and applied directly to the root zone area of the crop by the irrigation system. This practice provides an excellent opportunity to maximize yield and fertilizer use efficiency (Gupta *et al*., 2010) [3].
Solanum melongena L. commonly known as brinjal, eggplant or aubergine, belongs to family Solanceae and is cultivated in the temperate regions of the world. Brinjal is one of the most common tropical vegetables grown in India. It is known by different names like aubergine (French), begun (Bengali), ringna (Gujarathi), baingan (Hindi) badane (Kannada), waangum (Kashmiri), vange (Marathi), baigan (Oriya), Kathiri (Tamil), venkaya (Telugu) and Peethabhala (Sanskrit). It is also cultivated throughout the year in almost all the states of India except at higher altitudes. Brinjal or Eggplant is a warm season plant. It is grown generally twice or thrice in a year and fruit is available practically throughout the year. India is the second largest producer of vegetable next to China. Its fruit has a very high nutritive and medicinal value. Brinjal fruit contains high amount of moisture (91.5%), carbohydrates (6.4%), protein (1.3%), and fat (0.3%) (Aykroyd, 1963) [1].

2. Materials and Methods
The experiment was carried out at Instructional Farm of Department of Irrigation and Drainage Engineering, Dr. PDKV, Akola, during rabi season of 2021-22.

The experiment was conducted with an objective to determine fortnightly total water requirement, water use efficiency and yield of hybrid brinjal crop. During the period of experimentation the meteorological data was obtained from Agricultural Meteorological Observatory, Department of Agronomy, Dr. P.D.K.V. Akola. An appropriate drip set was needed to irrigate the crop using drip irrigation. Accordingly, the layout was prepared and the pipeline for irrigation was installed. Through the pipe lines set up at the experimental site, the water was conveyed to the inline drip.

The field experiment was conducted in randomized block design, with four replications and five treatments of different fertigation levels. The treatments details are given in Table 1.

Table 1: Treatment details

Treatments	Specification
T_1	Drip fertigation with 75% of RDF
T_2	Drip fertigation with 100% of RDF
T_3	Drip fertigation with 125% of RDF
T_4	Drip fertigation with 150% of RDF
T_5	Traditional application of fertilizer with 100% RDF (Soil application of basal dose of 50% N + 100% P + 100% through solid fertilizers at the time of transplanting and remaining 50% N in two equal splits at 30 and 45 DAT) – Control

2.1 Experimental Details

The details of experiment are given below.

Table 2: Experimental Details

Sr. No.	Particulars	Specifications
1	Crop	Brinjal
2	Scientific name	*Solanum melongena* L.
3	Variety	Phule Krishna
4	Experimental Design	Randomized Block Design
5	Number of treatments	5
6	Number of replications	4
7	Number of plots	20
8	Plot size	5.4 m × 3 m
9	Season	Rabi
10	Crop spacing	0.90 m X 0.75 m
11	Crop period	180 days
12	Recommended fertilizer dose	150:75:75
13	Date of sowing	30/09/2021
14	Date of transplanting	16/11/2021
15	Period of picking	18/01/2022 to 01/05/2022

2.2 Water Requirement of brinjal

Before transplanting, to bring the soil at the field capacity in each plot common irrigation was applied on 16th November 2021. On 16th November 2021 healthy seedlings of brinjal were transplanted with spacing of 90 cm (row to row) and 75 cm (plant to plant). The successive first irrigation was given on 18th November 2021 and then irrigation was applied every alternate day according to the previous two days cumulative evaporation.

The depth of irrigation water required for all treatments to bring it up to field capacity was calculated by using equation

$$d = \left(\frac{Mfc - Mbi}{100}\right) \times \gamma \times Z \times 1000 \quad \text{------(1)}$$

Where,

D	= Net depth of water to be applied during an irrigation, mm
Mfc	= Moisture content at field capacity, per cent
Mbi	= Moisture content before irrigation, per cent
Y	= Bulk density, g/cm^3
Z	= Depth of effective root zone, m

The effective root zone depth was taken as 45 cm for calculating the net water requirement of brinjal crop. The moisture content before transplanting was taken and it was observed 26%. Accordingly, the depth of irrigation to be applied before transplanting was calculated.

2.3 Water requirement of brinjal under drip irrigation

Considering the use of polyethylene mulch, which saves about 20% of irrigation water (Gaupale, 2017 and Sankpal, 2016) [2, 5], the water requirement of brinjal crop under drip irrigation was worked out at 80% evapotranspiration level. It was worked out on the basis of pan evaporation.

The amount of water to be applied per plant was calculated by using Dick Krupp's formula given in equation 2.

$$Q = A \times B \times C \times D \quad \text{------ (2)}$$

Where,

Q	= Water requirement per plant (lit/plant)
A	= $ET_o = E_{pan} \times K_p$ (mm)
B	= Crop coefficient (K_C)
C	= Canopy factor
D	= Area allotted per plant (m^2)
E_{pan}	= Cumulative evaporation for two days
K_p	= Pan coefficient (0.8)

2.4 Fertilizer application, scheduling and doses

The recommended fertilizer dose of 150:75:75 N:P:K Kg/ha was taken. In case of treatments T_1 to T_4, water soluble fertilizers (source- 19:19:19 WSF complex and urea) through drip fertigation was applied in 15 splits at an interval of 10 days. Out of which, during first 60 days after transplanting (DAT) i.e. in vegetative growth stage; half of respective total fertilizer dose was applied in 6 equal splits at an interval of 10 days and remaining half of respective total fertilizer dose was applied after 60 DAT in 9 equal splits at an interval of 10 days as per fertilizer level in respective treatment.

In control treatment T_5, soil application of basal dose of 50% N + 100% P + 100% K (sources – Urea, SSP, and MOP) were given as traditional fertilization through solid fertilizers at the time of transplanting and remaining 50% of N (source-Urea) was given in two equal splits at 30 and 45 DAT through drip fertigation, as mulching were provided.

Table 3: Schedule of fertigation in drip fertigation treatments (T_1 to T_4)

Split number	Date
I	16th November 2021
II	26th November 2021
III	6th December 2021
IV	16th December 2021
V	26th December 2021
VI	5th January 2022
VII	15th January 2022
VIII	25th January 2022
IX	4th February 2022
X	14th February 2022
XI	24th February 2022
XII	6th March 2022
XIII	16th March 2022
XIV	26th March 2022
XV	5th April 2022

3. Results and Discussion

3.1 Amount of water applied to brinjal crop

The daily climatological data was collected from Agricultural Meteorological Observatory, Department of Agronomy, Dr. PDKV, Akola during the period of investigation. Considering the two days cumulative pan evaporation, the amount of water to be applied per plant of brinjal was calculated from this data, by using equation 2 on alternate day basis.

The depth of irrigation applied before transplanting was found to be 25.54 mm to bring the soil to its field capacity accordingly. The amount of water applied to brinjal crop under drip irrigation is presented in Table 4.

Table 4: Amount of water applied to brinjal crop

Period	Amount of water applied at 80% ET (lit/plant)	Amount of water applied at 80% ET (mm)
Common irrigation before transplanting	17.24	25.54
Second fortnight of November 21	6.94	10.28
First fortnight of December 21	5.99	8.87
Second fortnight of December 21	8.08	11.96
First fortnight of January 21	7.18	10.64
Second fortnight of January 22	18.40	27.26
First fortnight of February 22	23.76	35.20
Second fortnight of February 22	34.35	50.88
First fortnight of March 22	34.96	51.79
Second fortnight of March 22	66.46	98.45
First fortnight of April 22	74.00	109.63
Second fortnight of April 22	63.56	94.17
First fortnight of May 22 (Up to 1st May)	10.94	16.20
Total(lit/plant)	371.85	-
(lit/ha)	5508829.66	-
(mm)	-	550.88
(ha-cm)	-	55.09

Table 4 shows the fortnightly total water requirement of hybrid brinjal crop, by giving alternate day irrigation amount in that respective fortnight for the growth period of the brinjal crop.

From Table 4, it is noticed that the, total irrigation water requirement of brinjal crop was found to be 550.88 mm in rabi season under 80% ET level. Thus, amount of water applied to brinjal crop through drip irrigation at 80% ET level with polyethylene mulching was 55.09 ha-cm.

At 100% ET level, the total water requirement of brinjal crop was found to be 460.50 lit/plant (at 100% ET) but we can reduce the water requirement to 371.85 lit/plant under 80% ET in water scarce situations and we can bring some additional area under cultivation with this 20% saved irrigation water. This reveals the major advantage of water saving in drip irrigation with introduction of polyethylene mulch.

3.2 Yield of brinjal and water use efficiency

The complete harvesting of brinjal crop was done in 15 pickings from time to time. The data pertaining to average yield of brinjal as influenced by drip fertigation with different fertilizer levels and traditional method of fertilizer application presented in Table 5.

The yield of brinjal was influenced significantly due to different fertigation levels. Treatment T_4 (Drip fertigation at 150% RDF) recorded significantly highest yield of brinjal (470.33 q/ha) which is followed by treatments T_3, T_2 and T_1. However, treatment T_4 (Drip fertigation at 150% RDF) was found statistically at par with treatments T_3 (Drip fertigation at 125% RDF). The brinjal yield obtained under treatment T_5 (Traditional fertilization at 100% RDF, 346.65 q/ha) was found lower than the treatment T_2 (Drip fertigation at 100% RDF, 415.39 q/ha). Lowest yield of brinjal was observed in treatment T_5 (Traditional fertilization at 100% RDF, 346.65 q/ha) as compared to all drip fertigation treatments, which may be due to less availability of nutrients at flowering and fruiting stage of crop, as whole fertilizer dose was given in vegetative growth stage itself in this treatment.

Table 5: Yield of brinjal and water use efficiency as influenced by drip fertigation with different fertilizer levels and traditional method of fertilizer application

Treatments	Yield (q/ha)	Amount of water applied (ha-cm)	Water use efficiency (q/ha-cm)
T_1 (Drip fertigation at 75% RDF)	362.04	55.09	6.57
T_2 (Drip fertigation at 100% RDF)	415.39		7.54
T_3 (Drip fertigation at 125% RDF)	467.98		8.50
T_4 (Drip fertigation at 150% RDF)	470.33		8.54
T_5 (Traditional fertilization at 100% RDF)	346.65		6.29
F Test	Sig.	-	-
SE (m) ±	16.67	-	-
CD at 5%	51.38	-	-
CV%	8.09	-	-

It was also seen that yield of brinjal in treatment T_4 was found to be higher than that of treatment T_3, which was statistically at par. But treatment T_4 required 25% more amount of fertilizer than treatment T_3. Hence, the advantage in treatment T_3 was requirement of 25% less amount of fertilizer than T_4. So, the treatment T_3 may be suggested as the best treatment, considering the requirement of less amount of fertilizer in treatment T_3 than treatment T_4.

In traditional fertilization treatment, yield level may be low due to application of 50% N, 100% P and 100% K nutrients as a basal dose at the time of transplanting and remaining 50% N at 30 and 45 DAT through the drip fertigation. As a whole recommended dose of fertilizer was given in initial growth stage which may result in leaching of nutrients in later stages, which affect the less availability of nutrients at flowering and fruiting stage of crop. Whereas, the higher yields in drip fertigation treatments may be due to regular availability of optimum quantity of nutrients to plants by frequent application of nutrients in 10 days interval; avoiding leaching of soluble fertilizers applied with measured and required amount of irrigation water. Whereas, When we consider the optimization of treatment through second degree polynomial equation the application of T_3 (Drip fertigation at 125% RDF) would be the optimum dose for brinjal fruit yield (467.98 q/ha) (Fig. 1).

Treatment T_4 (Drip fertigation at 150% RDF) was recorded highest water use efficiency (8.54 q/ha-cm) followed by treatments T_3, T_2, T_1 and T_5 which may be due to higher yield. However, treatment T_5 recorded lowest water use efficiency, which may be due to lowest yield level in this treatment.

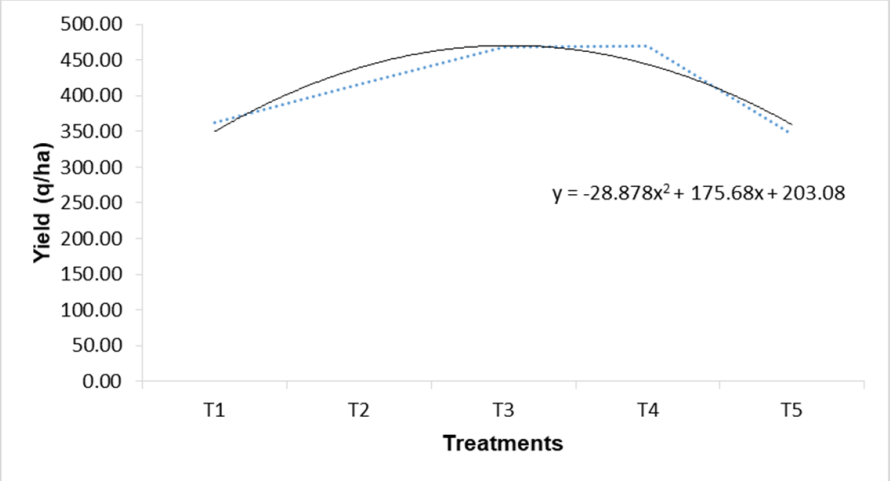

Fig 1: Graph showing the optimum fruit yield of brinjal through the second degree polynomial equation

4. Conclusions

Total irrigation water requirement of brinjal crop was found to be 550.88 mm under 80% ET level i.e. 371.85 lit per plant. Treatment T_4 (Drip fertigation at 150% RDF) recorded significantly highest yield of brinjal (470.33 q/ha) which was found statistically at par with treatments T_3 (Drip fertigation at 125% RDF) (467.98 q/ha). Treatment T_4 (Drip fertigation at 150% RDF) was recorded highest water use efficiency (8.54 q/ha-cm) followed by treatments T_3, T_2, T_1 and T_5.

5. References

1. Aykroyd WR. Composition of brinjal fruit. ICMR Special Rept; c1963. p. 42.
2. Gaupale AN. Effect of polyethylene mulch and drip fertigation on production of chilli crop. M. Tech thesis, Dr. PDKV, Akola; c2017.
3. Gupta AJ, Ahmed N, Bhat FN, Chattoo MA. Production of hybrid tomato for higher income under drip irrigation and fertigation in Kashmir valley. Indian J Hant. 2010;67(1):127-131.
4. Michael AM. Irrigation theory and practice (second edition), vikas publishing house private limited; c2008.
5. Sankpal MN. Performance of tomato under polyethylene mulch and drip fertigation. M. Tech thesis, Dr. PDKV, Akola; c2016.